Part 5: Evaluating Landfill Gas Potential

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Outline

- Objectives
- Rough Approximation Method
- Model Estimates
- Field Testing
- Summary

Objectives

- Estimate the current and future quantities of gas that will be generated and may be recovered at a landfill
- Information is used for landfill gas project planning and design
- 3 methods available

Landfill Gas Generation

- Amount of LFG production is governed by:
  - amount of waste
  - type of waste
  - age of waste
  - moisture content
  - temperature
  - pH
- These factors cannot be easily modified
- LFG production peaks about one year after waste placement and decreases 2% to 8% per year thereafter

Rough Approximation Method

- Simplest method
- Assumes that each metric ton of waste will produce approximately 6 m^3 of landfill gas per year
- Waste should be less than 10 years old
- Production rate may be sustained for approximately 5 to 10 years

Rough Approximation Method - Confidence Levels

- This approach is used for initial project planning and screening (not for system design)
- Estimates in the range of approximately +/- 50 % accuracy

USEPA LanGem Model

- **First Order Decay Equation**
- **Takes into account site specific information**
- **Rate constants can be adjusted for regional climatic conditions**
- **Best used for landfills with greater than 1 million tons of waste in-place**

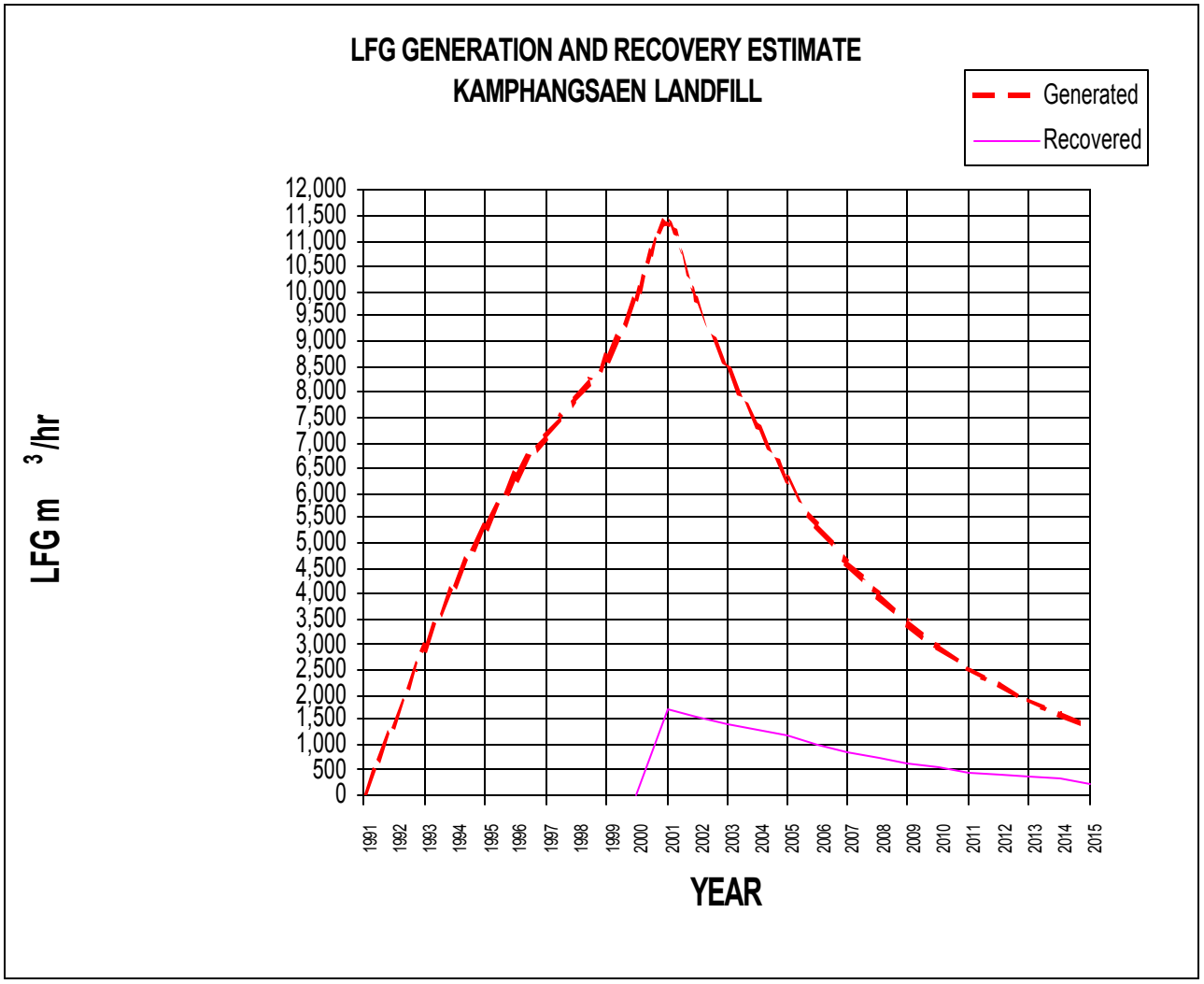
USEPA LanGem Model

- USEPA model is widely used in the LFG industry
- USEPA model consistent with Intergovernmental Panel on Climate Change Protocols (IPCC) for calculating greenhouse gas emissions inventories
- Other LFG models available

Model Estimates

- Projects Landfill Gas Generation Rate
- Projects Landfill Gas Recovery Potential
- Confidence Levels

Model Output



Methodology

- **USEPA Landfill Gas Emissions Model**

$$Q = L_o R (e^{-kc} - e^{-kt})$$

- **Develop Site-Specific Inputs:**
  - **Methane Generation Potential (Lo)**
  - **Methane Generation Rate Constant (k)**
- **Projected Methane Generation and Recovery Rates**

Key Inputs

- Year Landfill Opened
- Annual Acceptance Rate
- Quantity of Waste In-Place
- Remaining Disposal Capacity
- Landfill Closure Date
- Precipitation

Methane Generation Potential (Lo)

- **Range of Values:**
  - 0 – 312 (m^3CH_4/Mg)
- **USEPA Default Values:**
  - CAA – 170 (m^3CH_4/Mg)
  - AP42 – 100 (m^3CH_4/Mg)
- **Suggested Local Value:**
  - Approximately 140 - 180 (m^3CH_4/Mg)

Methane Rate Constant (k)

- **Range of Values:**
  - **0.003 – 0.4 (1/yr)**
- **USEPA Default Values:**
  - **CAA – 0.05 (1/yr)**
  - **AP42 Wet Climate – 0.04 (1/yr)**
  - **AP42 Dry Climate – 0.02 (1/yr)**
- **Suggested Local Value:**
  - **Approximately 0.05 - 0.15 (1/yr)**

Projected LFG Generation Rate

- Model output provides an estimate of annual methane generation rates
- Generally assumes landfill gas contains 50 % methane

Projected LFG Recovery Rate

- **The actual LFG recovery rate will depend on the following:**
  - **LFG collection system coverage (% = radius of influence/landfill area)**
  - **LFG recovery system collection efficiency (depe on collector design and landfill characteristics)**

Projected LFG Recovery Rate, continued...

- **Expected range:**
  - **60 to 85 % of projected landfill gas generation rate**

Confidence Levels

- **Sources of Uncertainty:**
  - **Method**
  - **Data quality**
  - **Collection efficiency of the landfill gas system**
  - **Other factors**
- **Estimates in the range of +/- 25 % for initial years**
- **Greater variances in the longer term**

Field Testing

- Install test wells
- Perform testing and monitoring
- Field Testing Issues
- Confidence Levels

Install Test Wells

- Install as many vertical extraction wells or horizontal collectors as possible in representative portions of the landfill
- Flare recovered gas to control discharge

Perform Testing and Monitoring

- Balance the well field
- Recover LFG on a continuous basis during the testing period
- Monitor gas quality at each well and at the flare station
- Review results

Field Testing Issues

- **Advantages:**
  - Provides site-specific data
  - Provides information on landfill leachate levels
- **Disadvantages:**
  - May over-estimate sustainable LFG recovery rate
  - May not provide information on seasonal variations

Confidence Levels

- Sustainable gas yields may be only 50 % of results from a field testing program
- Extend testing program to increase confidence levels and verify landfill gas resources

Summary

- Information on LFG recovery rates is a critical element in project planning and sizing of utilization equipment
- 3 methods available
- LFG modeling combined with field testing provide the best results
- Field testing should be performed on a continuous basis over an extended period